Ohio State's Contributions to Science

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(A Paper Given at Sigma Xi Initiation)

Inasmuch as this meeting constitutes a part of the exercises held in honor of the fiftieth anniversary of the founding of the University, and inasmuch as the Society of Sigma Xi stands for achievement in the realms of science, pure and applied, it would seem appropriate on this occasion that there should be some mention of the outstanding contributions which the University has made to the advancement of science. My theme might be termed "The University's Contribution to Science," with the understanding, however, that I shall confine my discussion to the contributions made by the members of the instructional staff of the University. In a broad sense one of the greatest contributions to science, perhaps the greatest, which the University has made, is the training of a large number of men and women, thoughtful men and women, who left their alma mater, imbued with the spirit of research, of investigation and of achievement.

You men who have this morning been initiated into the Society of Sigma Xi, belong to this class and I can assure you that the Society is proud to welcome you here and to bestow upon you some slight recognition in honor of your achievements.

To discuss the productive work done by these sons and daughters of the University, in the field of science, would be a delightful task to any friend of the University—so numerous and so important have been these contributions; but to tell the story at all adequately would require not one but a series of addresses. Even though I confine my statements to the contributions made by members of the instructional staff of the University, you will appreciate the fact that I can do but little more than barely mention the most important of these contributions. It would seem fitting that stress should be placed upon the work of those who constituted the faculty in the earlier periods of the University's existence. I may add that in the selection of the topics included in this discussion, I have had the assistance of those who are qualified to judge of the work done in different fields of activities and to these I express my appreciation. However, I wish it distinctly understood that this discussion lays no claim to completeness. Rather may it be taken as enumerating typical examples of the productive work accomplished.

And first let me speak of some of the departments whose history begins with the history of the University. Among these, I mention first the work of Edward Orton. On Wednesday you heard President Thompson give an appreciation of Orton as the first president of the University. Anyone who was fortunate enough to have studied under him will tell you he was a great teacher, but after all his greatest achievement consisted in his contributions to science. Orton was State Gelogist of Ohio from 1882 to 1899. In this capacity he contributed greatly to a knowledge of the Geological structure of the state and to its mineral resources. There was scarcely a nook or cranny in the state that he had not tramped over. It was during this period that natural gas was discovered in Ohio and his work on this subject led him to formulate a theory of the origin of natural gas and petroleum—a theory which has stood the storm of criticism and is still generally accepted. His work on fuels was especially noteworthy. In much of this work on fuels, he had as his collaborator Nathaniel W. Lord, of whom I shall speak later. His investigations have stood the test of time and his major conclusions have never been questioned.

The work of Orton in urging conservation of our national resources must ever be regarded as a work of supreme importance. Although his stand, especially in reference to the conservation of natural gas was ridiculed, time has amply justified his prophecies. After his death the geological work of the state was continued by other members of the Department of Geology and a great deal of work has been completed on the Devonian, Mississipian, Pennsylvanian and Permian strata, while the investigation of the economic products, such as clays, building stones, salt, limestone, coal and gas, has gone steadily forward. As some one has stated, "The Geological Map of Ohio is largely an Ohio State University product."

If Orton was a leader in the field of Geology, so was Mendenhall in the domain of Physics. Both Orton and Mendenhall were great teachers and both were skilled investigators. Indeed their work as teachers was catalyzed through their interest and participation in the investigations conducted along the boundary lines between the known and the unknown. In short, they were great teachers largely because they were investigators. Mendenhall's work on the electrical units was fundamental in character. His definitions of the ampere, volt, and ohm were practically those adopted by the International Electrical Congress in 1893. His invention of the "Mendenhall half-second pendulum" made possible exceedingly accurate work in the determination of the constants of gravitation and is still used in a modified form by the United States Coast and Geodetic Survey. His election to membership in the National Academy of Sciences as well as in the American Philosophical Society attest the character and importance of his scientific achievements.

Succeeding Mendenhall, Benjamin F. Thomas did pioneer work in the study of rapidly varying phenomena in electrical circuits, particularly the distribution of E. M. F. around the commutator of dynamos. He was an authority on photometry and was a member of the jury of awards at the Chicago Exposition in 1893. In later years, important work has been carried on in the domain of Physics on the Hall effect and allied phenomena, on electric waves, on magnetism, on electron tubes, on discharge of electricity through gas, and on the properties of natural gas.

In the field of Mechanical Engineering the work of Stillman W. Robinson stands out boldly in a number of different lines of investigation. He

was consulting engineer for the Warner and Swasey Company in the construction of the Lick telescope. When natural gas was discovered in Ohio, Orton appealed to him for a method which would make possible the accurate measurement of the gas as it flowed from the wells. The use of the Pitot tube suggested itself at once and the method devised by Robinson, based on this principle, has been in use in the measurement of gas flows ever since. Robinson was granted no less than forty patents. The last one taken out only a short time before his death was for a machine used in the grinding of toric lenses.

More recent investigations in the field of mechanical engineering have dealt with boiler feed water regulators, with exact measurement of the flow of water and air, with the economical use of liquid fuels in gas engines, and with problems connected with clutch couplings, the sand blast machine and the ignition timing device for gas engines.

In electrical engineering most stress has been placed upon problems pertaining to lighting, especially upon the proportioning of the general and local lighting so as to get the best results.

In Agricultural Chemistry the work of Henry Adam Weber bearing upon the question of pure foods, has been a potent factor in bringing about the present high standards of purity. It is not many years ago when adulterated foods were sold broadcast; today it is almost the exception to find an adulterated product on the market; and it is to Weber and a limited group of other workers that credit must be given for the inception of the work that has resulted in bringing about this condition—a condition which has such an important bearing upon the health of the nation. In more recent years the Department has also contributed notably to certain problems of nutrition, problems bearing especially upon the assimilation of fats. other than glycerides. Likewise the Department of Soils, of Farm Crops and of Horticulture have in progress experiments which must extend over a number of years in order to reach final conclusion, but which promise to give information of great value to the production of increased food supplies—a subject that is of the greatest importance to our country.

In the field of Botany, Kellerman's investigations in Mycology were noteworthy contributions. He was the founder of the Journal of Mycology, which is still published under the name of "Mycologia" in connection with the work of the New York Botanical Gardens. Other investigators have dealt with the succession of plant associations on prairies; with the ecology of farm crops. The discovery of the Valley of Ten Thousand Smokes, as well as the numerous investigations carried on in connection with this newly discovered region, is also the work of the Department of Botany. Another line of investigation in Botany that has attracted wide attention has a bearing upon certain facts expressed in Mendel's law of heredіy, especially in its bearing upon the production of sex. The results indicate that sexuality is probably not of the nature of ordinary hereditary characters which are known to have their basis in the chromosones but that it is related to the physical and chemical properties of the living matter and that the proper understanding of its nature will take us into the field of positive and negative electricity with all of their attending phenomena.

The name of Nathaniel W. Lord will always be associated with pioneer investigators on the general subject of fuels. His paper on "The Calorific Value of Certain Fuels as Determined by the Calorimeter," published in the Transactions of the American Intsitute of Mining Engineers in 1897, as well as that on "The Valuation of Coal," given before the A. A. A. S. at Boston in 1898, led to his selection as Director of the Fuel Laboratory of the U. S. Geological Survey at St. Louis and later to his appointment by President Roosevelt as consulting engineer on an advisory board to the fuel investigation work of the Geological Survey. I well recall the year previous to the beginning of the great war, that while visiting a number of universities and technical schools in Switzerland, a country in which the fuel question is ever to the front, Lord's work was spoken of everywhere with the greatest appreciation. In addition to the work on fuels, his publications cover investigations on a wide range of subjects—on iron and steel, cement, blast furnace tar, fertilizers, and water supply. The work on fuels is being continued in the Departments of Metallurgy and Mine Engineering at the present time and results have been obtained that promise to lead the way to a more economical use of our fast waning fuel supply.

In the field of Zoology and Entomology, the period from 1887 to 1897 under the guidance of Kellicott was very productive in original work. These investigations covered a wide field, but the most important of them lay in the domain of aquatic zoology, especially the lower invertebrates and fishes. The investigations also include a systematic study of the dragonflies. The results of the investigations are given in numerous papers which appeared in the publications of the Ohio Academy of Science and in other scientific journals. It is worth while to note that during this period, the Lake Laboratory of the University was established. This laboratory was founded as a research institution, and has always been maintained as a center of biological research for Ohio and adjoining states.

In later years, extended researches have been carried out along many lines, but especially in economic and systematic entomology and some of these at least have had important economic bearings. Special stress is being given at present to the many problems connected with the propagation of fishes in Ohio waters, in the hope that a larger supply may be available as food. The research spirit of the Department is manifested in the fact that no less than 125 of its graduates have gone into professional scientific work connected with research in some form and most of them into positions of large responsibility. The Department has also had an active part in the publications of the Ohio Biological Survey.

In the domain of Ceramics, the University is the pioneer. While many perplexing and important problems still await solution in this field, nevertheless the advance made in recent years has been remarkable. I think I may truthfully say that the noteworthy achievement of having taken the subject of ceramics from the "rule of thumb" basis and placing it on a scientific foundation may be traced largely to the work of the Department

of Ceramics of the University. In addition to the work of the members of the instructional force, the theses submitted by the graduates of the Department covering a wide range of subjects, such as glazes, flues, vitrification, composition of porcelain, have been of a high order of merit. I am informed that the thesis contributed by Albert V. Bleininger in 1901, when he graduated, is still a standard work on the subject of Portland cement. The American Ceramic Society owes its existence to the men of the Department and the annual publications of this society are still very largely contributions from the instructional force and the graduates of the Department of Ceramic Engineering.

If the geological map of Ohio is an Ohio State University product, so is the topographical map of Ohio. In addition to the work involved in developing this map, the Department of Civil Engineering has served the state in various construction enterprises. The plans proposed for the disposition of the surface waters so as to prevent the recurrence of any such disaster as that of 1913, show a marked comprehension of the subject and have received the commendation of eminent engineers.

Since the field of Chemistry is so extensive, it is but natural that the contributions of the Department of Chemistry to science should be along a number of rather widely separated lines. Some of these have had to do with the problems connected with the determination of the structure of certain organic compounds; also the products of oxidation of certain organic compounds, especially the alcohols, under different conditions. Other important investigations have been in the field of electrolytic preparation of amalgams, the changes involved in wood distillation; the utilization of the mother liquors from the sugar beet industry; the study of incesticides, brines, and paints, especially black metal paints. Much additional information has been obtained bearing on the structure of standard cells, and some light has also been thrown on the structure of complex organic compounds, while certain highly refined analytical methods have been developed for the determination of important chemical data. It may be mentioned that since the organization of the Graduate School in 1911, 150 students have received their Master's degree with Chemistry as a major; while of the 43 students who have been granted the degree of Doctor of Philosophy by the University during this same period, 20 had Chemistry as a major. Many of these students are now occupying positions in which research work plays a prominent role.

In the domain of Astronomy the most important work accomplished has been in the determination of the radial velocity of stars. The velocities of 31 stars were measured—a task that extended over ten years and time and necessitated the taking of approximately one thousand spectograms. A mathematical investigation bearing upon the methods employed in determining the sun's motion with reference to the stars is also a work of importance.

In the field of Anatomy investigations extending over a number of years have dealt almost entirely with the development of cerebral ganglia. These invstigations have been published in the Journal of Comparative Neurology. There have also appeared from time to time in public health and sanitation journals, papers relating to problems that lie within the field covered by these journals. A number of papers have also been published dealing with the clinical aspects of materials secured in the University hospitals. Mention should also be made of the certain investigations dealing with proteins and with the blood pressure in animals.

In recent years, the Department of Psychology has been one of the most active in the University, in the attention given to research work. Its publications at present probably exceed those of any other department. While the investigations cover a wide range of subjects, special stress has been placed on the various practical tests, which are gradually bringing Psychology into the realm of the exact sciences. The Department cooperated in the formation of the tests used in obtaining a basis for the proper classification of 2,000,000 soldiers of the late war. The so-called "Performance Tests" as well as the "Point Scale for the Measurement of Mental Ability," both used so largely in the army, were largely products of the Department..

And now in conclusion permit me to add a word in regard to the outlook for productive scholarship in the University. The scientific achievements made during the progress of the war have been of the most profound importance. It may be, however, that even of greater importance is the lesson learned by the allied nations in regard to the value of research work as a constructive agent in the advancement of the welfare of a nation. As President Schurman has stated, "It is by the enlargement of human knowledge that progress in civilization and improvement in the life and conditions of mankind are rendered possible." It was the results obtained during the war, however, that brought home to the different countries this great lesson and led the nations to take active steps to encourage and promote research in every possible way. And what is the result?

England already has appropriated over five million dollars as an initial endowment for a department of science and industrial research. Canada, Australia, Japan and Italy have all taken similar steps ,while the United States has established a National Research Council which is endeavoring to mobilize the scientific workers of the country and to coordinate their efforts so that the work may be carried on with the great efficiency. There is little doubt but that the next half century will witness the greatest achievements in scientific investigation ever made. Problems of the greatest importance to the welfare of the nation are awaiting solution. In all this work the universities have always taken the lead. There is little doubt but that they will continue to do so in the future. Our own University played an honorable part in the winning of the war. I trust and believe that it will continue to do its share in helping to solve the great problems now awaiting solution.

To do this effectively some way must be found for relieving members of the instructional force skilled in research work, from an excessive amount of routine work in connection with the incoming of large numbers of students. Less

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stress must be laid on numbers and more upon the quality of work done. Adequate tools must be provided in the way of laboratory equipment and library facilities. Above all, productive scholarship must be encouraged by those in authority. We need not, however, be ashamed of our past record. It is an honorable one under the conditions that have prevailed. Let us hope that the dawn of this new half century upon which the University now enters will witness the birth of a more earnest spirit of productive scholarship to the end that we may serve our state and humanity in general more effectively not only through the dissemination of knowledge but by opening up new and fertile lands.